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Abstract

A technique is described for a very rapid thermal treatment of a substrate used to make semiconductor devices. The substrate is subjected to a very hot gas stream such as can be produced from an arc-type plasma generator. The substrate is then moved through the hot gas stream at a velocity selected to sufficiently heat the surface of the substrate to a high temperature at which doping and diffusion processes can be done in an efficient manner, while a thermal gradient is preserved throughout the thickness of the substrate. In this manner as the substrate moves through the hot gas stream a rapid heating of the surface is achieved and as the heated portion moves out of the gas stream, the bulk of the substrate can assist in the cooling of the heated portion. Sharply defined doping regions can be formed in the substrate. The method yields temperature heating and cooling rates of the order of 10^5 °C/sec, peak temperatures up to the melting point of a substrate such as silicon without permanent distortion or introducing defects into the substrate, enables very fast low temperature annealing and activation with peak temperatures of 300° to 1000°C, provides process uniformity and throughput needs for silicon device manufacturing.